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ABSTRACT

This teacher's guide contains a unit of study for teaching about energy in grades seven, eight, and nine. The guide is self-contained and includes the handouts students need to work out the activity problems. The unit is developed around the concepts of shortage, scarcity, tradeoffs, investment, and decision making. Students develop these concepts by examining data from both the social sciences and the natural sciences. By participating in several decision-making activities students develop participatory skills as well as an understanding of the problems involved in energy decisions. The activities in which students are involved are many and varied and include using the newspaper headlines to identify effects of a fuel shortage, using graphs and cartoons to define scarcity, and studying the appeals in advertising slogans to identify some of the ways attitudes are formed toward or away from conservation. The packet is divided into four units each of which contains two or three lessons. It is designed to last approximately two weeks. The unit can be extended if the teacher chooses some of the optional decision-making or research activities. Teacher background information on energy is also provided in the guide. (Author/RM)

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Grades 7,8,9, Social Studies

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TEACHER GUIDE

INTRODUCTION

The major goal of The Energy Future Today is to help seventh, eighth, and ninth grade students gain a greater understanding of the complexities and implications of the major energy decisions that must be made. The quality of life in both the present and the future depend on how these decisions are made. These decisions involve the use of fossil fuels, conservation, and allocation of scarce supplies as well as short and long term development of alternative energy resources.

The unit is developed around the concepts of shortage, scarcity, tradeoffs, investment, and decision-making. Students develop these concepts by examining data drawn from both the social sciences and the natural sciences. By participating in several decision-making activities students develop participatory skills as well as an affective understanding of the problems involved in energy decisions.

The packet is divided into four units each of which contain two or three lessons. It is designed to last approximately two weeks. If the teacher chooses some of the optional decision-making or research activities, the time may be longer.

Throughout the packet alternative teaching and learning strategies are provided. The teachers can choose the methods that are most appropriate for their teaching styles and the needs of the students.

TEACHER MATERIALS

The portion of the energy curriculum materials directed to the teacher includes:

An Overview which briefly describes the major thrust of each lesson;

Concepts and Major Understandings to be developed in the unit;

Objectives which state in behavioral terms what performance should be expected of the students;

A list of Materials needed to conduct each lesson.

STUDENT MATERIALS

Each lesson includes two or three student handouts. These materials can be prepared for distribution to each individual student on a Xerox, Thermofax machine or by making a duplicating master. In addition, some of the material may be reproduced as transparencies for use on an overhead projecto This is particularly appropriat for chart and graph interpretation.

UNIT OVERVIEW

Unit 1

This unit helps students to distinguish between shortage and scarcity. Shortage is a short term concept. There is a sudden change in the supply or demand for energy.

Scarcity is a long term concept in which the demand for energy exceeds the supply of energy.

Decisions dealing with shortage generally are concerned with how the available fuel should be allocated. Decisions concerning scarcity deal with how demand can be reduced or supply increased.

To develop an understanding of these concepts of shortage and scarcity students interpret cartoons, graphs, and headlines. They participate in two situations in which decisions must be made, one of shortage and one of scarcity.

Unit 2

One strategy for dealing with scarcity in the short term is conservation. Conservation decisions involve a more efficient use of existing energy resources. Decisions to conserve energy are a function of the technology, lifestyle, previous decisions made by individuals, government and industry, as well as values, attitudes, and cost benefit analysis.

Students read a series of case studies, complete a conservation attitude questionnaire. and examine graphic data to understand and identify possible conservation decisions and the factors that inhibit or encourage the implementation of these decisions.

Unit 3

A second strategy for dealing with energy scarcity is to increase the supply of energy.

In the short term, that is by 1985, the energy supply increases will probably come from greater production of coal, from solar heating and/or nuclear fission. Each of these alternatives involve tradeoffs and require investment.

From a bar graph students identify short and long term energy supply options. An analysis of the President's energy research and development budget helps students to understand the role of investment in energy development. Students examine data sheets on coal and nuclear fission. After identifying the costs and benefits of these options, students participate in a mock Presidential cabinet meeting. The purpose of the meeting is to prepare a policy statement.

Unit 4

Long term energy options include, among other things, the development of nuclear fusion, electricity from solar power, coal gasification. Again, these decisions involve tradeoffs, investment and values.

Students examine data about these technologies and identify the costs and benefits. As a concluding exercise, students write a letter to the President outlining an energy policy.

TEACHER BACKGROUND INFORMATION

Solar Collectors

Solar collectors are generally in the shape of a flat box perhaps three feet on a

side and a few inches thick. The inside of this box is blackened and it is covered with a transparent sheet. When oriented toward the sun, usually by placing it on a south-facing roof, the blackened surface is heated by solar radiation. Circulating air or water through this box carries the absorbed heat to some storage device such as a tank of water.

To use the heat stored in this water tank, coils of tubing serving as "heat exchangers" are placed in the tank permitting a fluid to be heated as it passes through the tank. In the simplest terms, space heating could be accomplished by passing air through the tank and into the building to be heated. Hot water could be obtained by simply passing water through the tank. Interestingly, this tank of hot water can also provide for space cooling. A "working fluid" is converted from liquid to vapor phase by passing through the tank and the vapor circulates through pipes in the building and absorbs heat. The same process is used in gas refrigerators.

There are many designs for solar collectors, as well as the storage and circulation components. All are somewhat experimental so the economics are rather unknown. Solar energy is not uniformly available, being obviously affected by average cloudiness and latitude. While it is judged that all regions of the U.S. have some potential for using solar energy, we have too little experience to know the potential in all regions.

Coal Gasification

Coal is an attractive resource, at least in the intermediate term (the next 50 years), because it is so much more plentiful than natural gas or oil in the U.S. Estimates suggest that the U.S. has at least ten times the recoverable energy in the form of coal as it has in natural gas and oil. The difficulties of using coal are primarily environmental. Mining, particularly the strip mining of our western coal, is disruptive of the land. Burning coal directly in industry or in electric generating plants leads to polluting the air with compounds of sulfur and nitrogen. Elaborate equipment to remove these pollutants from the "stack gasses" is an expensive solution.

By converting coal to a combustible gas, the air pollution problem can be avoided. In the process of gasification, the coal is heated in the presence of hydrogen and converted to a gas of a carbon and hydrogen compound such as methane (CH^4). In the process, the contaminants such as sulfur are removed. The resulting gas can be transported and burned cleanly and easily as a substitue for natural gas. It can also be used as a source of chemicals for industry.

Methods and plants for gasifying coal have been present for decades, but all currently

available methods produce a gas that is more expensive than available alternatives. Current research is expected to improve the methods and as both the costs are reduced and the price of the alternatives increase, gasification is likely to be adopted.

The primary problems remain the disruption of the land for mining and the need for large quantities of water for the process. Much of the coal lies in the dry western states where water is already at a premium and in great demand for irrigation. In the future, the environmental damage of mining may be avoided if we learn to gasify coal in the ground without mining it first.

Nuclear Fusion

The primary attraction of nuclear fusion is that the fuel supply is essentially unlimited, while the primary discouragement comes from the difficulty of achieving a controlled fusion reaction. The process involves fusing together very light nuclei which produces energy. The commonly considered reactions are to combine deuterium (an isotope of hydrogen) with itself or with tritium (another isotope of hydrogen). Both reactions produce energy and by-products that are not dangerously radioactive. Though these special forms of the hydrogen atom (or isotopes) are much less common than the basic hydrogen atom, they are still very plentiful. Deuterium is found in one water molecule of every 6500. Considering the water in the world's oceans, there is enough deuterium to supply twice the world's current energy consumption for 50 billion years. Thus, the supply of the resource is no problem.

But the technology is a problem. To accomplish a fusion reaction requires that the particles be confined and heated to 100 million degrees centigrade or higher. No materials can withstand these temperatures, so we must seek new methods of confinement. Laboratory experiments are currently being conducted using lasers or magnetic fields, but the status of these efforts, after 20 years of hard work, is that we have still not successfully obtained as much energy out of the reaction as has been used in heating the materials. At this point we do not know how to produce a controlled fusion reaction, although much research is still going on. Opinions on the likelihood of success differ.

It should be mentioned that the sun's energy results from just such fusion reactions. There the confinement is accomplished with gravity. The hydrogen bomb is also a fusion reaction but hardly controlled as required for our purposes.

If we learn how to sustain a controlled fusion reaction, much work will remain until the process can be used to produce energy commerically. We must develop materials and systems to safely remove the

heat from the reactor and put it to use, probably by generating steam to power electric generators. This commercialization of the fusion process will take many additional years and is expected to be extremely expensive.

WHEN SUDDENLY THERE IS NO MORE

Overview Students examine a series of headlines from the coal strike of 1978 to see some of the effects of a sudden shortage of fuel. Students make decisions about how to allocate fuel after a shortage cuts off needed fuel supply.

Concept Shortage

Major Understanding A sudden change in the supply or demand of an important item such as energy may cause a shortage that can affect many aspects of the society.

Student Objectives Students should be able to:
1. Define shortage by giving examples.
2. Infer from data the effects of a shortage of energy.
3. Evaluate different decisions about allocating resources during a shortage.

Time Allotment One class period

Materials
1. Headlines: "The Coal Strike of 1978"
2. "What to Do When the Oil Doesn't Arrive"

Procedure	Commentary
ACTIVITY 1 *Coal Strike Headlines* Inferring Distribute coal strike headlines. Ask the class to solve the puzzle of what kind of event could have caused these headlines.	Although this is a coal strike, an embargo, transportation strike or shutdown or severe weather could stop the supply of coal or other needed fuel. As an optional introduction or extension, explain some of the background of the strike. The coal miners,

Procedures

Commentary

who previously had a very strong union, were severely divided. Union leaders could not enforce an agreement. During the previous two decades, some coal miners were paid high wages, but many were unemployed. The accident rate and job related sicknesses, such as black lung disease, have made coal mining a dangerous job. Owners of the mines said that they could not afford to meet all the demands. After several months of negotiation, the President envoked the Taft Hartley Act because he saw the strike as a threat to national security. Workers threatened not to obey the injunction.

Classifying

Students identify the multiple effects of the coal strike. This may be done in a number of ways.

1. Students can answer the questions on the Headlines Handout alone or in small groups.

2. Advanced students could categorize the effects of the shortage as economic, social or political.

Economic - job layoffs.
Political - President orders workers back to work; authority questioned.
Social - fear of crime.

3. Generate with the class a list of the effects of the strike. Divide the class into small groups. Each group must arrive at a consensus of what is the most important and least important effect.

Procedures	Commentary
4. A formal or informal debate on alternative plans of coping with a shortage can be held.	Possible debate topics include "Schools should be closed in the winter," "All lights must be turned off at 11:00."

ACTIVITY 2

What To Do When The Oil Doesn't Arrive

Decision Making

Distribute "What to Do When the Oil Doesn't Arrive." Have the students work in small groups to complete the questions on decision making.

The students can then participate in a mock town council meeting (described on the back of the Handout).

Town Council Members
Mayor
Six Members
Reporter

All other class members are citizens and speak out for or against their plan.

or

An informal debate about different solutions would be appropriate.

Concluding the Lesson

Have students define the term "shortage."

A sudden change in the supply or demand for an item.

Accept answers that show they understand the term even if they do not use the words supply and demand.

Have students list other shortages they have experienced.

These can be personal, such as having unexpected dinner guests when there is only a limited amount of food; or national, such as a shortage of oil during the oil embargo.

WILL THERE EVER BE ENOUGH?

Overview Unlike shortage, scarcity is a long term phenomenon. In general, economists believe that the demand for an item like energy will always be greater than the supply of the item. In this lesson the students begin with a decision about how they would react if their income rose and then if the price of gasoline rose. They then examine a set of data showing how the demand for energy is increasing faster than the supply.

Concept Scarcity

Major Understanding When the desire for an item such as energy exceeds or grows at a faster rate than the supply of energy, a condition of scarcity exists.

Student Objectives Students should be able to:

1. Define scarcity.
2. Apply the concept of scarcity to the energy situation.
3. Interpret graphs and cartoons.

Time Allotment One class period

Materials "You and the Price of Gas"

Graphs and Charts: "Energy Consumption"
"The U.S. Energy Gap"

Procedures	Commentary
ACTIVITY 1	
Have the class identify any items that are scarce in their lives - Are there any items that they never seem to have enough of?	These could include time, money, friends.
If the class suggests money, brainstorm for a few moments: How many things would they like to buy? It is best if these are to be purchased from the students own income from allowance or work.	These can be listed on the board.

Procedures	Commentary
How do they decide which items to buy with their limited income?	
What would the students add if their income were to double?	
If their income doubled, would they get everything they wanted?	Probably not. Most wants increase with income.
Can they imagine ever having everything they wanted? Why or why not?	Some students will say yes. Their demands will stay constant.
Have the class develop a working definition of "scarcity."	In general, the desire for goods is greater than the supply of goods.

ACTIVITY 2
You and the Price of Gas

Distribute "You and the Price of Gas." Have the students answer the questions.	
Were the decisions easy to make? Which were easier? Harder?	
Can they think of any reasons why some people want the price of gasoline to rise?	It may get us to use less energy. Some companies may make a greater profit.
Would some groups of people have a more difficult time than others if the price of gas were to rise?	In general, the poorer the person, the more the person will be affected by a price rise.
Have the class offer other suggestions for getting us to use less gasoline. Can these be classified into increasing supply or decreasing demand solutions?	Rationing; building more public transportation; closing gas stations on weekends.

Procedures	Commentary
ACTIVITY 3 *Energy and Scarcity*	
Inferring from data	
Distribute graphs and charts. There are two general strategies for this activity:	
1. Have the students examine the data on the graphs and charts and generate their own questions.	For example, if we have more coal than any other energy resource, why don't we use more of it? What will happen when demand is greater than supply? Why are imports growing? Why don't we develop nuclear power?
or	
2. Have the students answer the questions on the data sheets singly or in groups.	
Concluding the Lesson	
Based on the two sets of data, what major problems are posed by the scarcity of energy?	A point to emphasize is that scarcity, unlike shortage, is long term.

CAN ANYTHING BE DONE?

Overview Students are introduced to the tradeoffs made when the supply of energy is increased or demand is decreased. First, students analyze a series of cartoons. They then compare the energy situation to a type of bank. Future withdrawals depend on the present rate of deposits and withdrawals. The future use of energy depends on the present use of energy as well as increases in the supply of energy.

Concept Supply and Demand

Major Understanding By increasing supply or decreasing demand, the severity of scarcity may be lessened, but to do so will require a set of tradeoffs.

Student Objectives The students should be able to:
1. Discuss the implications of tradeoffs.
2. Apply the concept of supply and demand.
3. Make inferences from cartoons.

Time Allotment One class period

Materials Cartoon Sheet 1 - "Our Energy Appetite"

Cartoon Sheet 2 - "Classroom"
"Pipelines"
"Bicycling"

World Energy Bank Handout

Procedures	Commentary
ACTIVITY 1 **Inferring from cartoons** Distribute Cartoon Sheet 1. If the students need help in interpreting cartoons, work with them through each of the questions.	

Procedures	Commentary
Alternatively, have students begin with the question of how this cartoon shows scarcity.	The appetite or demand for energy seems to be bigger than the supply of energy.
If the students were the "World Energy Doctor," what would they prescribe for the patient?	The answers could include eating less or consuming less energy or finding a way to feed the ever-increasing appetite for energy.
What is the problem with each "prescription?"	Some answers include the fact that supply of fossil fuels is finite and that people find it difficult to cut back on consumption.
Distribute Cartoon Sheet 2. This Cartoon Sheet with three cartoons may be used in a number of ways:	
1. The questions on the back of the sheet may be duplicated and distributed to the students.	This is suggested for students with little experience in cartoon interpretation or who need considerable direction.
or	
2. Distribute the cartoons without the questions.	
Have the class identify the cartoon that:	
A. Shows ways to use less energy.	Cartoon 1
B. May imply that we just live with scarcity.	Cartoon 2
C. Shows ways to increase the supply of energy.	Cartoon 3

Procedures	Commentary
What is the problem with each of the "solutions" offered in the cartoon?	Living with scarcity may be disasterous (Cartoon 1); supply increases may cause environmental damage (Cartoon 2); changes in transportation can be uncomfortable (Cartoon 3).
Ask the students if they can define the word "tradeoff."	The definition should include the idea that we give up something in order to get something else.
Have students identify a tradeoff in each of the cartoons.	Cartoon 1 may be trading off the future for the present; Cartoon 2, environment for energy; Cartoon 3, comfort for less demand of energy.
Which of the tradeoffs do they seem most comfortable with? Why?	
ACTIVITY 2 *The World Energy Bank*	
Before distributing the World Energy Bank sheet, ask the students what they would have to do if they wanted to buy an item that they couldn't afford.	Either they would have to save for it or they would have to figure out a way to get more money.
If we want to have more energy in the future, what must be done now?	Save energy or increase the supply of energy.
Hand out the Energy Bank sheet. Review with the students what each of the symbols for sources of energy mean.	These are the "deposits" in the energy bank.
Why are withdrawals from the bank increasing?	World Demand for energy is increasing rapidly. Industrialization and increased standard of living are two of the factors.

Procedures	Commentary
According to the picture, by how much will energy consumption have grown by the year 2000?	
How can "deposits" be increased?	New sources of energy could be found, new technologies introduced, scientific breakthroughs.
How can "withdrawals" be reduced?	By conservation or cutting down on present consumption or increasing the efficiency of energy use.
What are the problems with using less now?	The students can refer back to the cartoons or to their previous knowledge.
What are the problems with increasing energy supply?	

WHO DECIDED?

Overview After reading two case studies the students discuss how the individual, the government, and industry influence the amount of energy used in a family. Students write a brief case study of their own family in which they identify where energy conservation decisions could be made and what the advantages and disadvantages of these decisions would be.

Concepts Decision Making
Cost/Benefit

Major Understanding The ability to conserve energy depends on previous decisions, by the individual, the government, and industry as well as the present desire to save.

Student Objectives Students should be able to:

1. Identify direct and indirect uses of energy in a series of case studies and in their own lives.
2. Evaluate energy decisions in terms of cost and benefits.

Time Allotment One class period

Materials Case Studies 1 & 2

Procedures	Commentary
ACTIVITY 1 *Case Studies* Either divide the class in half and give one case study to each half or give both studies to all the students. The students could answer the questions individually. However, more interaction could be achieved through small group discussion.	

Procedures	Commentary
What are some of the uses of energy in the case studies?	The energy uses are both direct (e.g., fuel for cars) and indirect (e.g., synthetic clothing).
How do decisions by the family, government, and industry influence the amount of energy used?	Family decisions include choosing to live in certain areas; job choice. Government decisions include the building of roads and busing decisions for students. Industry decisions include airline schedules and apartment central heating.
What are some of the benefits and costs of energy conservation?	Energy conservation can save money but requires investment; moving closer to work may save energy and give more free time, but may mean giving up a desired lifestyle.
ACTIVITY 2	
Have students write brief "Energy Case Studies" for their own families. These cases can be duplicated for class reading and analysis.	Essays can include a description of all the energy used in the home by the family or how one person uses energy in the entire day. Students can recommend one way to save energy. They should explain some of the costs and benefits of this decision.
Some students may wish to devise a brief questionnaire to find out how and why they choose this method.	This questionnaire could include: How do you travel to work? Is there public transportation available? If there is, why do you use it or not use it?

Procedures

Note: Students should be reminded if they do interview people, that the identity of the people who are surveyed is kept confidential.

Some schools require permission from the principal before students conduct surveys.

Commentary

What could be done to encourage you to use more public transportation?

Do you drive a big or small car? Why?

WHY DON'T WE CONSERVE?

Overview Although most people agree in theory that energy should be conserved, there is much disagreement as to how this can be done. The factors that inhibit or encourage conservation include advertising, personal preference and costs. Students examine a variety of advertising slogans to see how these might affect their attitudes toward conservation. A brief survey of attitudes toward conservation is completed. Students identify some of the factors that help explain their attitudes and opinions about conservation.

Concept (Attitude) - Conservation

Major Understanding Decisions to conserve energy are made on the basis of knowledge, attitudes, cost, government sanctions and technology.

Student Objectives The students should be able to:

1. Infer from advertising slogans implicit attitudes toward the use of energy.
2. Evaluate energy conservation programs in terms of personal attitudes and needs.

Time Allotment One class period

Materials Energy Quotes

Student's Conservation Survey

Procedures	Commentary
ACTIVITY 1 *Energy Quotes* In a large group discussion or in small groups, have the students quickly examine the energy quotes.	
Have students sort or classify the quotes into those that may encourage the use of energy and those that may encourage the conservation of energy. Why?	For example: "Don't Be Fuelish" - Conserve, "Bigger is Better" - Use energy.

Procedures	Commentary
How could these quotes influence behavior?	This is an open-ended question. Some students will reject the whole idea. Others may be able to discuss the subtle impact of advertising.
What other types of advertising currently on T.V. or in the magazines or on radios encourage or discourage the use of energy?	
Is it easier to shift to using more or less energy? Why?	Most people find it easier to use more. High energy use often provides ease and pleasure. Reducing energy use can save money. A sailboat may be as much fun as a motorboat.

ACTIVITY 2

Conservation Survey

Have students complete the survey individually.

Compile the answers to the questions. These can be listed on the board.

For example:

Statement	Yes	No	Undecided
1			
2			
etc.			

Encourage student to express the reasons for their choices.

Students will probably disagree with each other. Ask for volunteers who are opposed to a particular viewpoint Have them explain their opinions to each other.

Procedure	Commentary
Tell the students that as a class they must reach a consensus about which of these proposals to recommend to the President or Governor.	
Why is this so difficult?	
If a consensus is reached, try to identify why this particular solution was favored.	Many times it will be because the students are not personally involved in these changes. For example, raising the price of gasoline may have little impact on wealthier students. On the other hand, closing school in the winter might seriously affect them.
Have the students identify a particular group or person who might support each of the proposals.	There are no directly right or wrong answer. Parents might favor raising driving age. Gas station owners might be particularly opposed to closing gas stations on Sunday. Persons living on lakes might like to ban motorboats or snowmobiles.
Which of these energy uses are necessities? Which are luxuries? What makes the difference?	These answers, to some extent, depend on students attitudes.
In conserving energy what tradeoffs are they willing to accept? What aren't they willing to give up?	
Concluding the Lesson	
Why should we conserve energy?	Students may refer back to the Supply and Demand graph from Unit 1.

WHERE SAVINGS CAN BE MADE

Overview Students identify areas in the economy where energy savings could be made. The potential costs of conservation are compared to the potential savings. Students distinguish between monetary costs and other economic and social costs.

Concept Cost/Benefit

Major Understanding Changes in technology and lifestyles, while requiring some present tradeoffs and investments, may save energy for future needs.

Student Objectives The students should be able to:

1. Identify sectors of the economy where major savings could be made in energy.
2. Identify some of the social and economic costs and benefits of conservation measures.
3. Interpret graphic data.

Time Allotment One class period

Materials Chart - "Where Energy Savings Could Be Made"

Procedures	Commentary
ACTIVITY 1	
Brainstorm with the students all the ways they can think of that they might have saved energy that day. How could they save energy directly? How could they save energy indirectly?	For example: Direct: Walk to school rather than drive; turn lights out; turn the heat down; eat untoasted bread; wash in cold water; not play a radio or T.V.; use a regular toothbrush. Indirect: Wear natural, rather than synthetic clothes; not waste food; not waste paper.
Why might they choose (or not choose) to conserve energy in this way?	

Procedures	Commentary
Which of these choices were under their control? Which of the choices were under the control of the parents or other authorities?	
Which of these savings would be easy to make; which difficult? Why?	
Would people of different economic levels have the same or different difficulties in making these choices?	
ACTIVITY 2 *Where Energy Savings Could Be Made*	
Distribute copies of the chart: "Where Energy Savings Could Be Made."	
Which of these savings could be made by changes in the way we live or lifestyle? Which would take major changes in technology? Which require both?	
If a barrel of oil costs $12, how much money would be saved by these changes?	
What if the price of oil doubled? What savings could be made?	
Using less energy will generally cost the consumer less money. What costs must the consumer take into account before deciding if it is economically profitable to invest in energy saving measures?	The cost of making these changes. How much does the insulation cost? How much would it cost to have high mileage cars?

Procedures	Commentary
Can some of these savings be made without financial cost?	Turning down a thermostat or car-pooling probably have no financial cost attached to them.
If these items don't cost money and they can save money, why don't people save energy in these ways?	Some people feel that the inconvenience of car-pooling or the discomfort of a lower thermostat are major costs.

WHAT CAN BE DONE NOW?

Overview A continued supply of energy in both the short and the long term requires planning now. In this lesson students are introduced to the idea that there are short and long term energy options. One of the major factors that will help determine if these options become a reality is present level of investment.

Concepts Short Term/Long Term
Investment

Major Understanding Increases in the supply of energy in both the short and long term require investment in technology and research today.

Student Objectives Students should be able to:

1. Distinguish between short and long term energy options.
2. Explain the role of investment in energy development.
3. Interpret a bar graph showing stages of alternative energy development.

Time Allotment One class period

Materials Bar Graph: "New Sources of Energy for Electricity"

Cartoon: "Energy Research and Development Budget"

Procedures	Commentary
ACTIVITY 1 *Wish List* Encourage students to fantasize all the great and beautiful things they would like to have in the future. Are any of these wishes contradictory? Which of these wishes are for themselves; which are for others? Which of the wishes do they think are possible before they graduate from high school? By the time they are thirty? In their lifetime?	As in all brainstorming, accept all answers.

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Procedures	Commentary
Which of these wishes use energy?	
Take one of the wishes that involve the simplest technological changes mentioned. Have the students identify all the things that would go into making this "wish come true."	The machines must be designed, tested and built. Money must be spent on machines and labor. The product must be sold at a price they can afford.
What must they do as individuals to make the wish come true?	
ACTIVITY 2 *New Sources of Energy*	
Distribute copies of "New Sources of Energy for Electricity."	
Explain briefly each of the technologies on the list. This is the nation's "Energy Wish List." What does this mean? Have the students locate on the bar graph when they will be 30, 45, and 60.	See appendix for brief description of these items.
These generally are the points of short term, medium term, and long term.	
What are some of the things that that must happen before the nation's "Energy Wish List" can come true?	Technological changes, research, investment.
ACTIVITY 3 *Energy Research and Development Budget*	
Have students examine the cartoon. Have the students define research and development.	
Based on this picture, what seems to be the order of importance for the government?	

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Procedures	Commentary
Why do you think this is so?	Answers are varied and often depend on who is speaking. The technology for nuclear energy is well developed. Conservation as a major policy has some political opponents.
How would the students divide the total energy research and development budget?	
Why don't we spend more on energy research?	It is difficult to spend money on something that will benefit the future.

33

COAL FACTS: COSTS AND BENEFITS

Overview Coal could be one of the major sources of short term increases in the supply of energy. Even under the most conservative estimates, the U.S. has enough economically recoverable coal to last well into the twenty-first century. However, the environmental, economic and social costs of coal production are high. The students examine the costs and benefits involved in various policies concerning the changes in the present production of coal.

Concepts Costs & Benefits
Policy

Major Understanding The supply of energy can be increased in the short run in the United States by developing and increasing the use of coal, but this will involve investment and tradeoffs.

Student Objectives The students should be able to:

1. Evaluate some of the costs and benefits of increased coal production.
2. Develop and evaluate a policy position on the development of coal reserves.

Time Allotment One-two class periods

Materials "The Coal Facts"

"Coal: The Costs and Benefits"

"The President's Cabinet"

Procedures	Commentary
ACTIVITY 1	
Introduce the students to the idea of costs and benefits.	
Remind the students of the shortage exercise in Lesson 1. Oil could not be delivered. Assume that the community decides to close down the schools.	

Procedures	Commentary
What can we infer about the way energy is used in the cartoon that is different from today?	There is no fuel available for "fun" purposes like a Sunday drive.
Describe what the "cartoon world" looks like, keeping in mind the fact that all energy must be used to its utmost efficiency.	Class may describe the housing, neighborhood, business district, what the kids and parents do during the day, how they get around, what is done for fun.
Can they see some advantages to this possible energy situation? What disadvantages?	
Speculate with the class about possible relations between the present and the future.	

ACTIVITY 2

Energy Decisions

Copy the "Possible Future Energy Situations" on separate pieces of paper. Divide the class into four large groups and give each group one possible future energy situation. This is passed from student to student, each one adding a one sentence consequence of the situation on the paper.

Encourage the students to build on what they already know about energy and on the original statement. These statements should be consequences the students think could be possible. For example, one answer for situation #1 could be "Everyone would starve to death."

Procedures

Commentary

ACTIVITY 3
The Coal Facts

Distribute copies of "The Coal Facts" and the analysis sheet, "Coal: The Costs and Benefits."

Be sure that the class understands each piece of data on the handout. Allow time for discussion of the data. Some terms may need to be explained to the students.

In small groups or individually, have the students complete the worksheet.

ACTIVITY 4
The President's Cabinet

Assign roles to the students. More than one person can serve as the Secretaries or each secretary can have several aides.

Have students prepare brief presentations to be made at the Cabinet meeting. Students can find the data for these presentations on "The Coal Facts" sheet.

To conduct the cabinet meeting arrange the chairs in an oval.

Although the President can keep order, the students should be told that cabinet meetings are very orderly and serious.

At the end of the discussion, the President must make the decision. The President does not have to do this on the basis of a vote.

Procedures	Commentary
After the meeting, the class can discuss if the President made a wise decision.	
What will the nation and Congress have to do to act on the President's decision?	Congress must pass laws; investments must be made.

NUCLEAR FISSION: COSTS AND BENEFITS

Overview The technology exists to provide electric power from nuclear fission. Some predictions state that nuclear fission may provide as much as twenty percent of the nation's electrical needs by 1985. Few suggestions for dealing with the scarcity of energy, however, are as controversial as the use of nuclear power. The students apply their knowledge of costs and benefits to the use of nuclear power.

Concept Cost/Benefit

Major Understanding The use of nuclear fission to provide an increase in the supply of energy in the near and mid-term is possible but involves a number of tradeoffs.

Student Objectives The student should be able to:
1. Identify some of the costs and benefits of increased use of nuclear fission.
2. Define nuclear fission.

Time Allotment One class period

Materials "Nuclear Fission: Costs and Benefits"

Procedures	Commentary
Have students examine the data on nuclear fission.	
As a class, have the students identify some of the costs and benefits of increased nuclear production.	A benefit could be increased energy independence; less environmental pollution, technology exists. Costs include radioactive danger, fear of thievery, need for investment.
Have an informal debate on: "Nuclear power should be increased in the United States."	More vocal students could prepare brief speeches. Two or three students can be on the affirmative side and a similar number on the negative side.

Procedures	Commentary
Concluding the Lesson	
What short term options are available to the United States for dealing with scarcity?	Among the options are heavy reliance on coal; heavy reliance on nuclear power; mix of nuclear and coal; increased imports of oil; development of alternative sources such as oil shale; conservation.

LONG TERM ENERGY OPTIONS

Overview Decisions made today will have multiple effects in the year 2000. It is difficult, however, for most people to project consequences that far into the future. In this lesson, students hypothesize about some of the long term effects of energy decisions that could be made today.

Concept Multiple Effects

Major Understanding Energy decisions made today will have multiple effects on the people and their lifestyles in the year 2000.

Student Objectives The student should be able to:

1. Trace the causes and effects of possible energy decisions.
2. Evaluate some of the tradeoffs that must be made in the present to insure an energy supply in the future.
3. Identify some of the reasons why it is difficult to plan for the future.

Time Allotment Once class period

Materials Cartoon: "Bedtime Story"

"Possible Future Energy Situations"

Procedures	Commentary
ACTIVITY 1	
Distribute the cartoon entitled "Bedtime Story." Ask students if they think the cartoon is set in the past, present or future. Why?	Approximately 30 years in the future. The father is probably one of them - their parents have 2 cars.
What in the cartoon is similar to our present lifestyle? What is different?	
What is the father telling the children about the energy situation of the past?	There was plenty of fuel available.

Procedures	Commentary
What can we infer about the way energy is used in the cartoon that is different from today?	There is no fuel available for "fun" purposes like a Sunday drive.
Describe what the "cartoon world" looks like, keeping in mind the fact that all energy must be used to its utmost efficiency.	Class may describe the housing, neighborhood, business district, what the kids and parents do during the day, how they get around, what is done for fun.
Can they see some advantages to this possible energy situation? What disadvantages?	
Speculate with the class about possible relations between the present and the future.	
ACTIVITY 2 *Energy Decisions*	
Copy the "Possible Future Energy Situations" on separate pieces of paper. Divide the class into four large groups and give each group one possible future energy situation. This is passed from student to student, each one adding a one sentence consequence of the situation on the paper.	
Encourage the students to build on what they already know about energy and on the original statement. These statements should be consequences the students think could be possible. For example, one answer for situation #1 could be "Everyone would starve to death."	
Write one situation on the board and the students' proposed consequences. Discuss these possibilities with the students evaluating the possible consequences. Could these really happen? Why or why not? What other events would need to occur in order for these events to happen?	An alternative plan: Write one situation on the board and have students volunteer consequences. Then discuss.

Procedures	Commentary
Is it difficult to think in terms of the future? Why? Why should we think about the future?	
Can you think of some events of 10, 20, 30 years ago that have affected us positively? Negatively?	
What is our impact on the future? Can we decide to have a certain kind of future and then make it happen? How? Should we?	Major Point: By the types of decisions we make today we can influence the type of lives we will have in the future. To some extent, the choice is between making the future or reacting to it.

LONG TERM TECHNOLOGY

Overview

The decisions about what mix of long term energy options for the nation are difficult. Massive investments are needed for research and development. These investments compete with other needed investments. Economists talk about scarce capital. There are more demands for investment money than the present supply. Moreover, there is great risk in investing in long term energy technology. It is possible that even with massive spending, electricity from the proposed sources will not be commercially feasible. Students examine some of the risks involved in long term investment. Students also explore the effect of not investing today.

Concepts

Risk
Investment

Major Understanding

Even with high levels of investment, long term energy technology may not produce the needed increase in energy supply.

Student Objectives

The student should be able to:

1. Identify some of the problems of producing electricity from solar power or nuclear fusion.
2. Explain the relationship between investment and future energy supply.
3. Evaluate the risks involved in long term energy investment.
4. Express a policy position in written form.

Time Allotment

One - two class periods

Materials

Data Sheet: "Electricity From the Sun"

Data Sheet: "Electricity From Controlled Nuclear Fusion"

Cartoon: "Energy Research and Development"
(Unit 3, Lesson 1)

Bar Graph: "New Sources of Energy for Electricity"

"Write a Letter"

Procedures	Commentary
ACTIVITY 1	
Distribute "New Sources of Energy for Electricity" and the cartoon "Energy Research and Development."	
Have the students look at the chart on new sources of energy. Which sources appear to be long term? Long term can be defined as a source that will not be commercially available before the year 2000.	
To reinforce the idea of how close the year 2000 is, again have the students figure out how old they will be in that year.	Most of them will be about 35 years old.
Have the students examine the cartoon "Energy Research and Development."	
In what long term options does the President wish to invest money? Which will get the most? The least?	According to the budget, the U.S. will invest in nuclear fusion and solar power. (Small sums of money will probably be invested in other sources as well.)
Does the President suggest that more money be spent on long term or short term options?	The budget has more money allocated for short term options.
Why might the President suggest that money be invested in this way?	Short term options have less risk; there may be more lobbying for certain types of development; there is some doubt that long range options are possible; people have a hard time planning far into the future.
ACTIVITY 2	
Distribute "Electricity From the Sun" and "Electricity From Controlled Nuclear Fusion" data sheets.	

Procedures	Commentary
Have the students read the description of how energy is released from the sun and from nuclear fusion.	This is an excellent opportunity to use the expertise of the science department. An excellent source of more detailed information about the processes summarized on the sheet are the Fact Sheets written by John M. Fowler at NSTA. Fact Sheets 4, 5, and 6 deal with solar power and 14 with nuclear fusion. These are available free from the DOE Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee 37830.
For each source of energy have the students identify some of the benefits and some of the costs.	
What risks would the nation be taking if it invested heavily in nuclear fusion?	There is no danger of nuclear fallout and only a small danger from radiation. The major economic risk is that all the investment might not pay off.
What risks are involved in solar development?	There are few risks in terms of danger. Again, there is the economic risk that the investment will not be successful.
ACTIVITY 3	
Distribute the handout "Write a Letter."	
Before the students write their letters, discuss possible policy positions.	These include: invest all money in one source - either nuclear or solar; have some mix of investment; make no investment.

Procedures

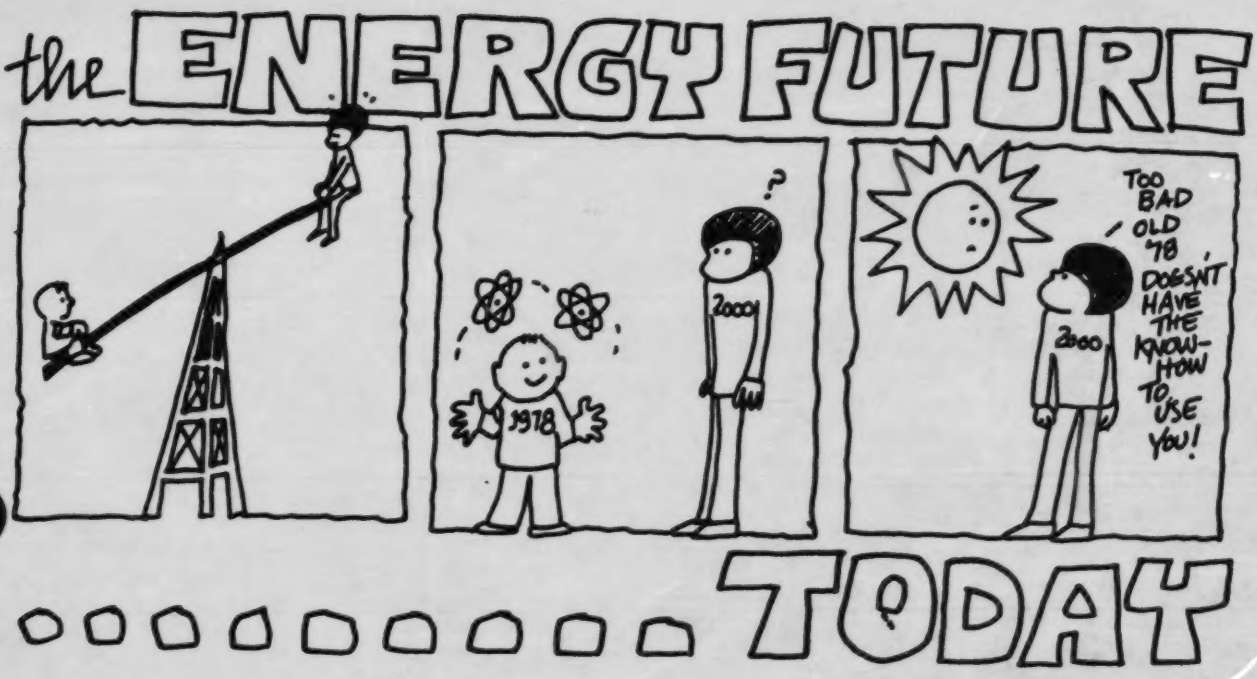
Ask the students why they think that the letter should contain some of the negative aspects of their proposal.

Commentary

This can be used to reinforce the idea of tradeoffs. No idea is perfect. In making decision, the President should know about the tradeoffs.

The letters can be sent to the White House or to the Congress. The students will get at least a form letter back.

Student Guide



SCHOOLS CLOSE
for 2 weeks

INDUSTRY CUTS BACK ELECTRICITY USE 50%

Detroit Lays Off 1,000 Workers

LIGHTS OUT- CRIME INCREASE FEARED

President Orders Coal Miners Back to Work

These headlines show some of the effects of the long coal strike of 1978. Which of these effects do you think are most serious? Which are least serious? Why?

Why might schools be ordered closed during a shortage of coal?

Why might you close industries?

What other alternatives are available for dealing with the shortage?

SHOW WHAT YOU KNOW

Choose one of the following:

Choose any headline. Write the article that would go with the headline.

Draw a cartoon that shows the meaning of the headline.

Write a letter telling the governor of your state how the energy shortage should be handled.

Research an energy shortage similar to the coal strike. Some examples are: The Oil Embargo of 1973; Fuel Shortages during World War I, Natural Gas Shortages of 1976-77. Include in your report the causes and effects of the crisis. How did the people cope with the shortage? What government actions, if any, took place?

WHAT TO DO WHEN THE OIL DOESN'T ARRIVE

A severe winter storm struck the entire New England region. All deliveries stop. An oil tanker making its way up the Bay was destroyed in the storm. One community was particularly hard hit by earlier storms and was very low in heating oil. A few oil trucks that had arrived in the community before the storm could make deliveries. If the oil was evenly distributed, all buildings would be out of oil after three days.

List as many reasons as you can for:

Delivering oil to all buildings	Delivering oil to some buildings
1.	1.
2.	2.
3.	3.
etc.	etc.

What other options were open to the community?

Choose the solution that you think was best for distributing the remaining oil.

What are the drawbacks to your solution?	What are the advantages to your solution?
1.	1.
2.	2.
3.	3.
etc.	etc.

Why did you choose your plan?

SHOW WHAT YOU KNOW

With your teacher, set up a mock town council meeting. You will need the following people:

Mayor	-	Keeps order, announces the vote, votes in case of a tie.
Six Council Members	-	Listens to reports, proposes plans, votes.
One Recorder	-	Keeps minutes.
Citizens	-	All other class members are to attend the board meeting. They are citizens of the community and have the right to speak out in favor of a proposal or against a proposal offered by someone else.

YOU AND THE PRICE OF GAS

As demand for energy increases, the price of energy may also go up. This price rise will happen if the supply of energy remains the same or grows more slowly than the demand for energy.

Some economists predict that the price of gasoline will increase to over a dollar per gallon. In some countries people already pay over two dollars for a gallon of gas. What is the price of gasoline in your town now?_____.

List five different ways your family uses a car.

1.

2.

3.

4.

5.

Which of these uses of the car would your family stop if the price of gas rose to:

$1.00

$1.50

$2.00

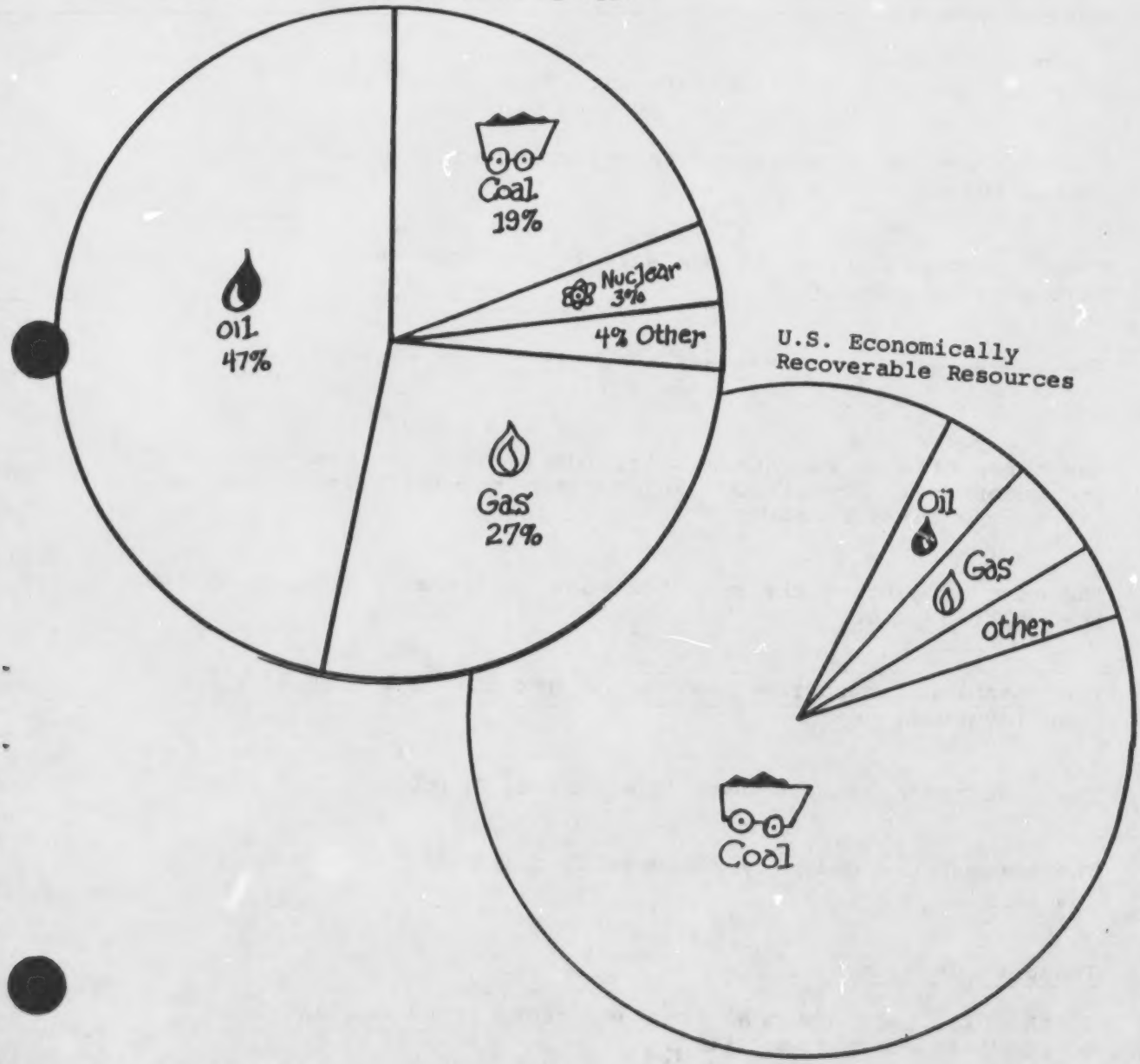
At what price would your family stop using a car?

If your family were very much richer than it is, would your decisions be different?

If your family were very much poorer, would your decisions be different?

What factors, other than price, influence how your family uses the car? For example - the nearness to public transportation.

1976 U.S. CONSUMPTION
% of total energy consumed by type



What does the term consumption mean?

What type of energy is used the most in the U.S.?

What percentage of energy consumed in the U.S. comes from nuclear power?

Coal, oil and gas are fossil fuels. What does this mean?

What percentage of our total energy consumption comes from fossil fuels?

These resources are sometimes said to be "non-renewable." What does that mean?

For a resource to be economically recoverable, several factors are necessary. See if you can complete the following sentences. Circle the correct answer.

The cost of getting the resource must be (greater than, less than) the selling price.

The (machines, resources) needed to get the fuel must have been invented.

The resource must have been (discovered, lost).

The largest economically recoverable resource in the U.S. is (coal, oil).

Thought Questions

If the U.S. has more coal than any other resource, why do we use less of it than oil?

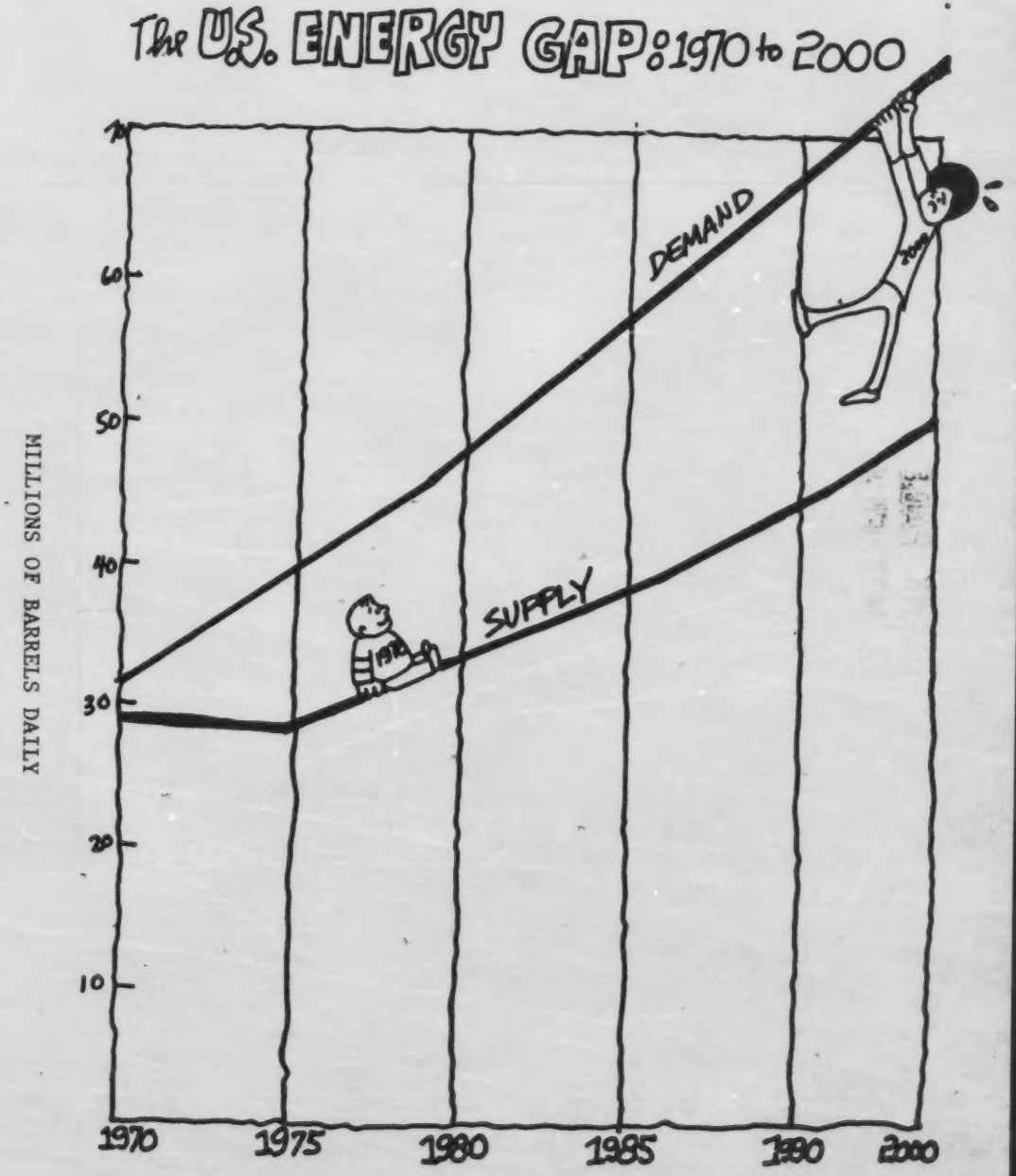
1. According to the graph, what happened to the demand for energy between 1970 and 1975?

2. According to the graph, what will happen to energy consumption by 2000?

3. What will happen to energy supply?

4. In 2000, there will be a gap. Using the words demand and supply write a statement that describes this gap.

5. Why is 2000 trying to pull down the Demand Curve?



OUR ENERGY APPETITE

What is 1978 eating?

Why is 2,000 concerned?

How does this cartoon express scarcity?

What will happen if 1978 continues to "eat" at the present rate?

What kind of a diet would you recommend for 1978?

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SHOW WHAT YOU KNOW

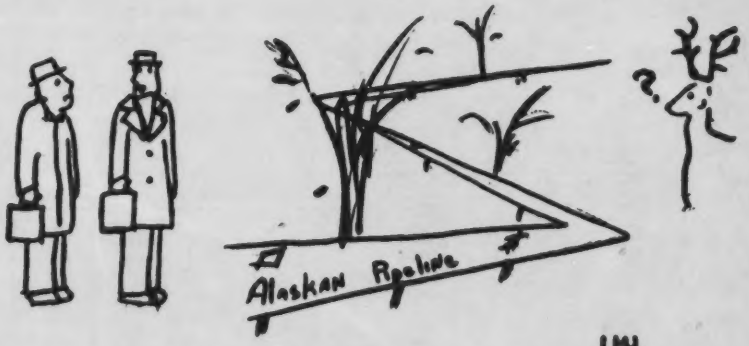
Choose one of the following:

1. Write an "Energy Diet for the World."

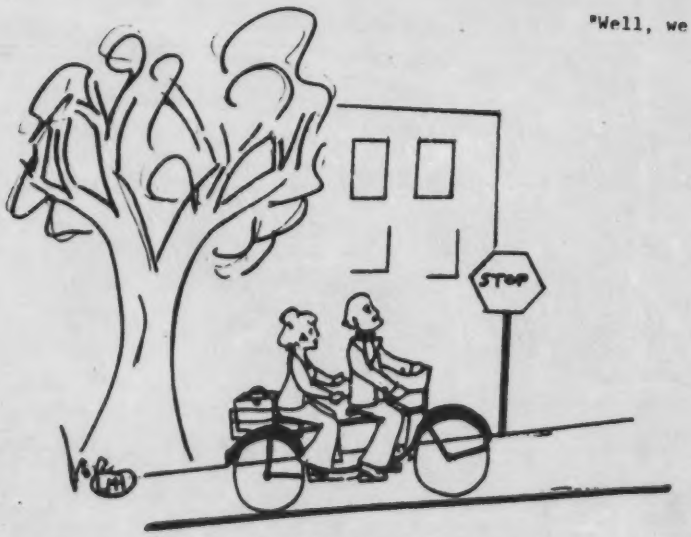
2. Draw 3 cartoons showing how you think the U.S. or the World should deal with scarcity.

3. Find 1 cartoon that shows something about the energy problem. Write 2 or 3 sentences about the cartoon.

4. Play World Energy Doctor. Write out a prescription for your patient. Say how World can decrease its appetite. As a Doctor, why do you recommend this diet?



"Well, we still have to work the bugs out."



"Darling, I thought you told me there wasn't an Energy Crisis?"

Cartoon 1

Classroom

Who is in the audience?

Who is the speaker?

What danger is he pointing out to the audience?

How does he say they should live with this danger?

What is your opinion of this method?

What do you think the cartoonist's attitude is?

Cartoon 2

Pipeline

What is the subject of the picture?

How is the pipeline supposed to deal with the problem of scarcity?

What tradeoffs were made in building the pipeline?

What is the cartoonist's attitude toward the pipeline? How do you know?

What questions should have been asked before building the pipeline?

Cartoon 3

The Bicycle

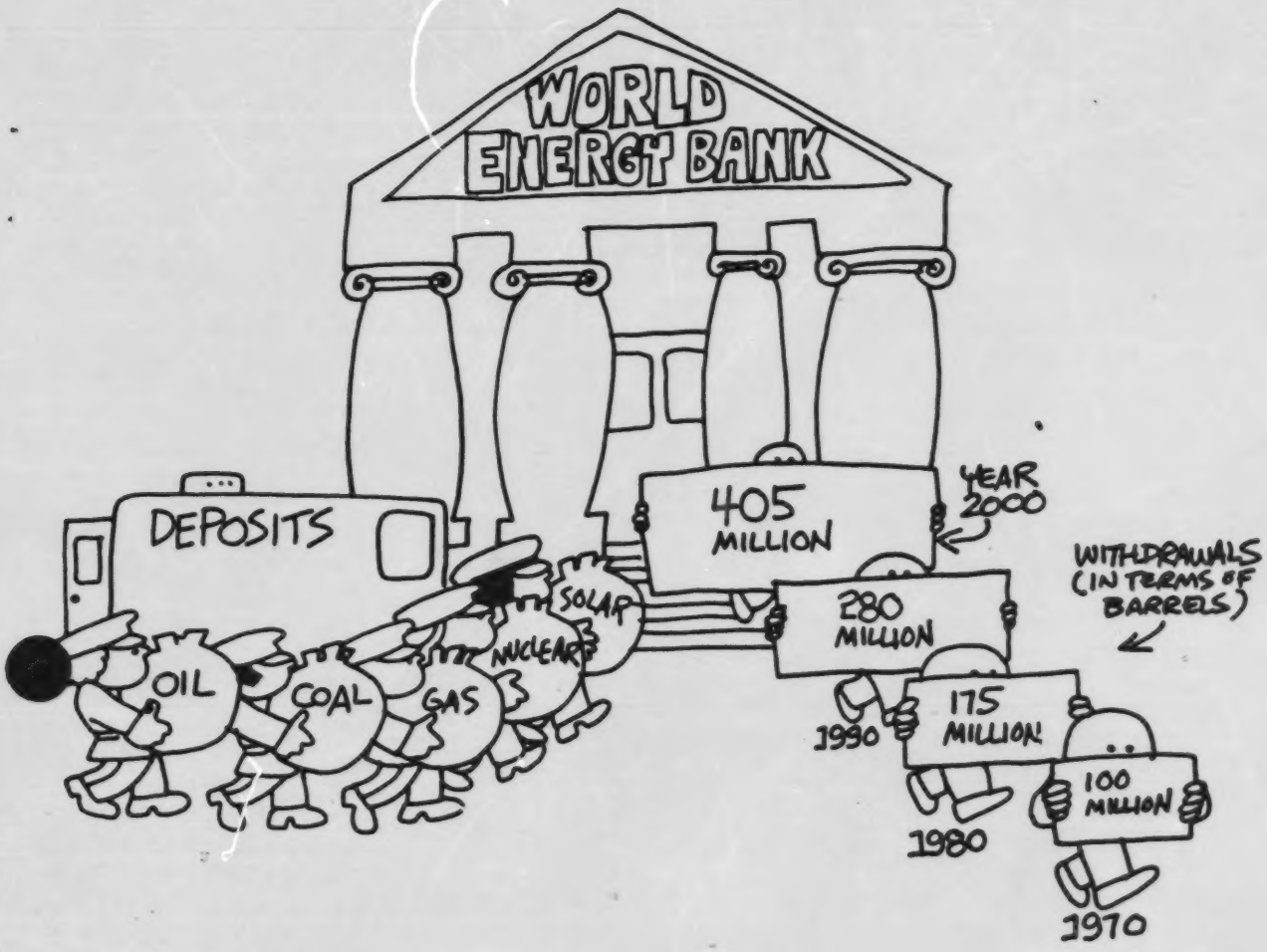
How does this cartoon deal with scarcity?

What change did they make?

Why did these people make the change?

Would people make these changes voluntarily? Why or why not?

THE WORLD ENERGY BANK



What are the deposits that are made in the energy bank?

What are the withdrawals?

Between 1970 and 2000 what seems to be happening to the size of withdrawals? Why?

What happens when you take more out of a bank than you put into it?

What must happen now if the people in the year 2000 are going to be able to withdraw energy from the bank? (Hint: Think about present deposits and present withdrawals.)

CASE STUDY

1

Mrs. W. is a traveling salesperson. She often travels over 100 miles a day. Sometimes she must carry displays. A big car makes this easier. She worries about the low gas mileage.

Occasionally, Mrs. W. must travel even longer distances. Since there are no trains, she takes a plane. In order to save money and fuel, the airlines have cut back on flights. This means that Mrs. W. must often stay overnight.

Mrs. W's children, ages 9, 11, and 15 travel a mile and a half to school. The youngest child gets bus service. To save money and energy, the school district does not provide bus service for junior or senior high students. Most of the time Mr. W. drives all three children to school in the family's second car.

The family lives in a large, old home. Although it stays cool in the summer, it is difficult to heat in the winter. More insulation would reduce fuel bills, but costs money.

List as many examples of energy use in the story as you can.

What decisions made by the family influence the amount of energy they use?

What decisions made by the government influence the amount of energy used by the family?

Name one way that the family could conserve energy.

Besides saving energy, what benefits would they get from this decision?

What changes in their life would the family have to make if they were to save energy in this way?

Mr. C. likes living in a big city. He teaches school in one of the suburbs twenty miles from where he lives. The only train that gets Mr. C. to school on time leaves at 6:15 a.m. Instead, he drives his small car to work.

The drive to work is easy. He crosses a toll free bridge and drives on a major highway. The bridge and the highway were built by the State and Federal government.

After school Mr. C. coaches basketball. This means that he can't drive to and from work with other teachers who live near him in the city.

The students in Mr. C's class sometimes get angry when he turns the heat down.

At his apartment, the heat is controlled by the building managers. It gets so hot in the winter that Mr. C. leaves the windows open.

Mr. C. has two children, ages 12 and 14. Both go to school in the city. They travel to school by subway.

List as many examples of energy use in the story as you can.

What decisions made by the family influence the amount of energy they use?

What decisions made by the government influence the amount of energy used by this family?

What decisions made by industry influence the amount of energy used by this family?

Name one way the family could conserve energy.

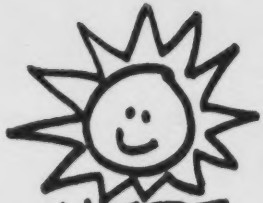
Besides saving energy, what benefits would they get from this decision?

What changes in their life would the family have to make if they were to save energy in this way?

ENERGY QUOTES

ENERGY FOR A STRONG AMERICA!

BIGGER IS BETTER!

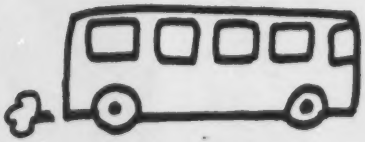


Live Better Electrically!

Don't be fuelish!

POOL IT!

Take a bus and leave the driving to us!



Keep off the gas!

Progress is our most important product!

ENERGY QUOTES

Take one of the energy quotes. Who might have written it? Why? Write a brief description about a society that would have this as its only motto.

Identify at least five advertisements on T.V. or in the paper that might encourage the use of or conservation of energy.

Write an advertisement that would encourage people to drive fifty five miles an hour.

Draw a cartoon that encourages energy conservation.

CONSERVATION SURVEY

Read each of the following statements carefully. Each one suggests a way to encourage the use of less energy by Americans.

Decide if you agree, disagree, or can't make up your mind about the statement. Before each statement:

Place an A if you agree.

Place a B if you disagree.

Place a C if you can't make up your mind.

_____ 1. Raise the price of gasoline by $1.00.

_____ 2. Raise the age at which a person can drive to 21.

_____ 3. Close gasoline stations on Sunday.

_____ 4. Lower anti-pollution requirements.

_____ 5. Ban the use of recreational vehicles like minibikes and snowmobiles.

_____ 6. Ban the use of motorboats.

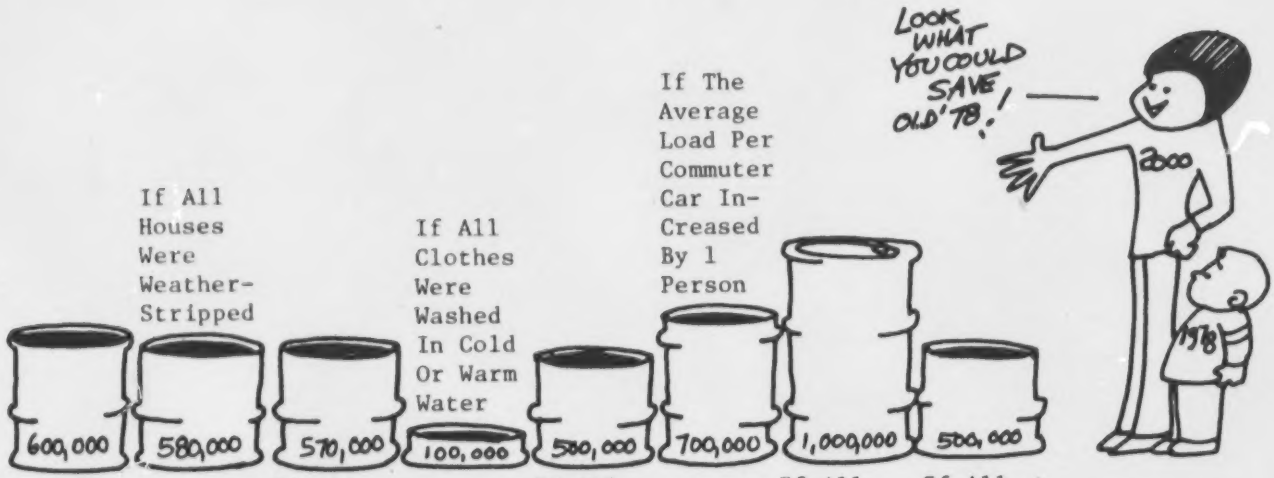
_____ 7. Lower the temperature to 17°C in all public buildings.

_____ 8. Close school in December and January and open them in the summer in cold climates.

_____ 9. Provide free public transportation.

_____10. Put tolls on all major roads.

Possible Energy Savings
(in terms of number of barrels of oil saved)


LOOK WHAT YOU COULD SAVE, OLD TB!
2000
1978
600,000
580,000
570,000
100,000
500,000
700,000
1,000,000
500,000
If All Houses Had 6" Insulation
If All Houses Were Weather-Stripped
If All Thermo-stats Were Set At An Average Of 60° F
If All Clothes Were Washed In Cold Or Warm Water
If All Appliances Were 20% More Efficient
If The Average Load Per Commuter Car In-Creased By 1 Person
If All Electric Motors Were 1% More Efficient
If All Cars Averaged 20.8 Miles Per Gallon Now

Which of these savings require changes in how we live?

Which of these savings require changes in technology?

Are there any that may require both changes in lifestyle and technology?

If a barrel of oil costs $12, how much money could be saved if:

a. All homes were insulated?

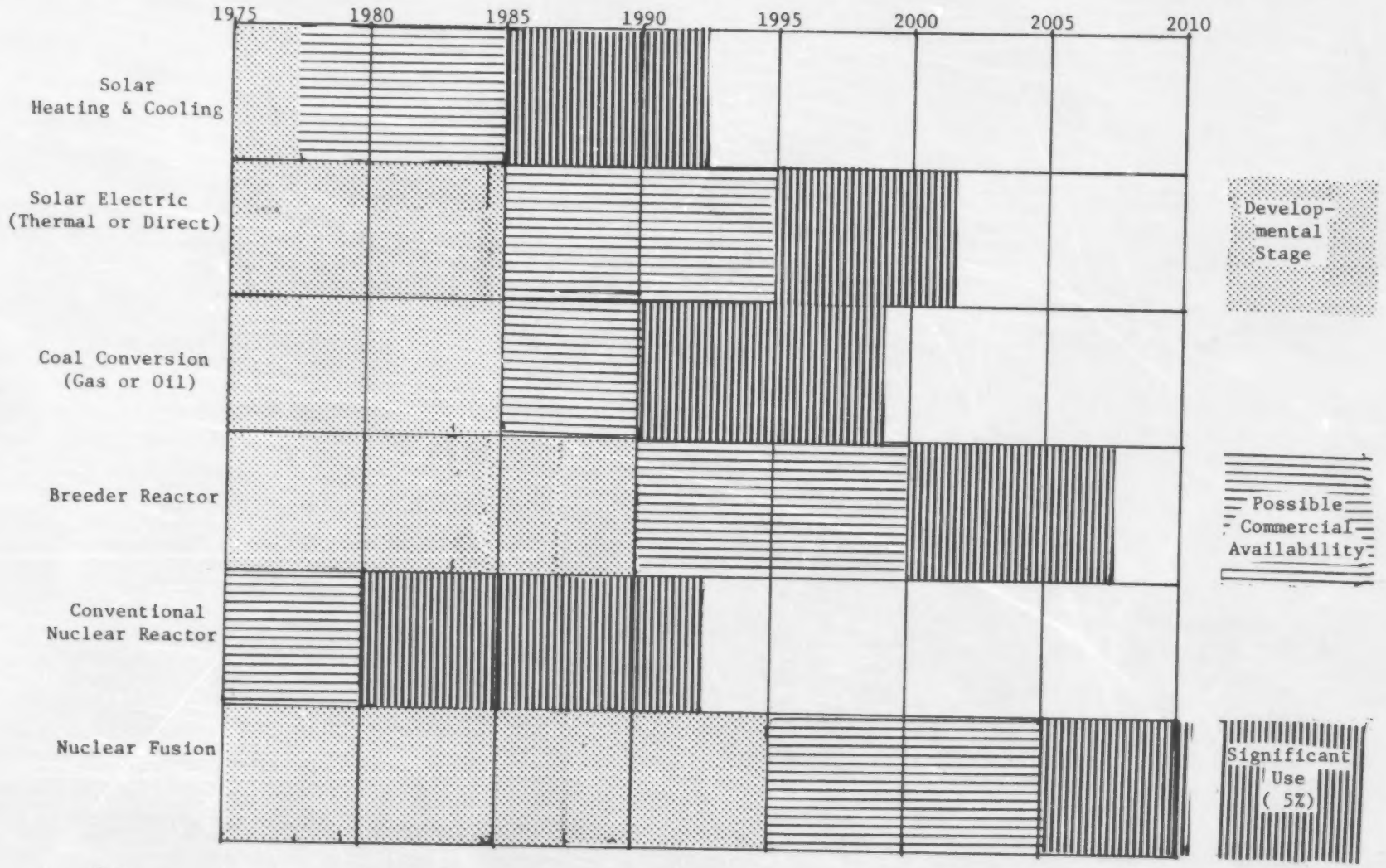
b. All appliances were more efficient?

c. All cars averaged 20.8 miles per gallon?

Some of these savings will require investments. An example of an investment is spending money on insulation now so that fuel bills will be lower later on.

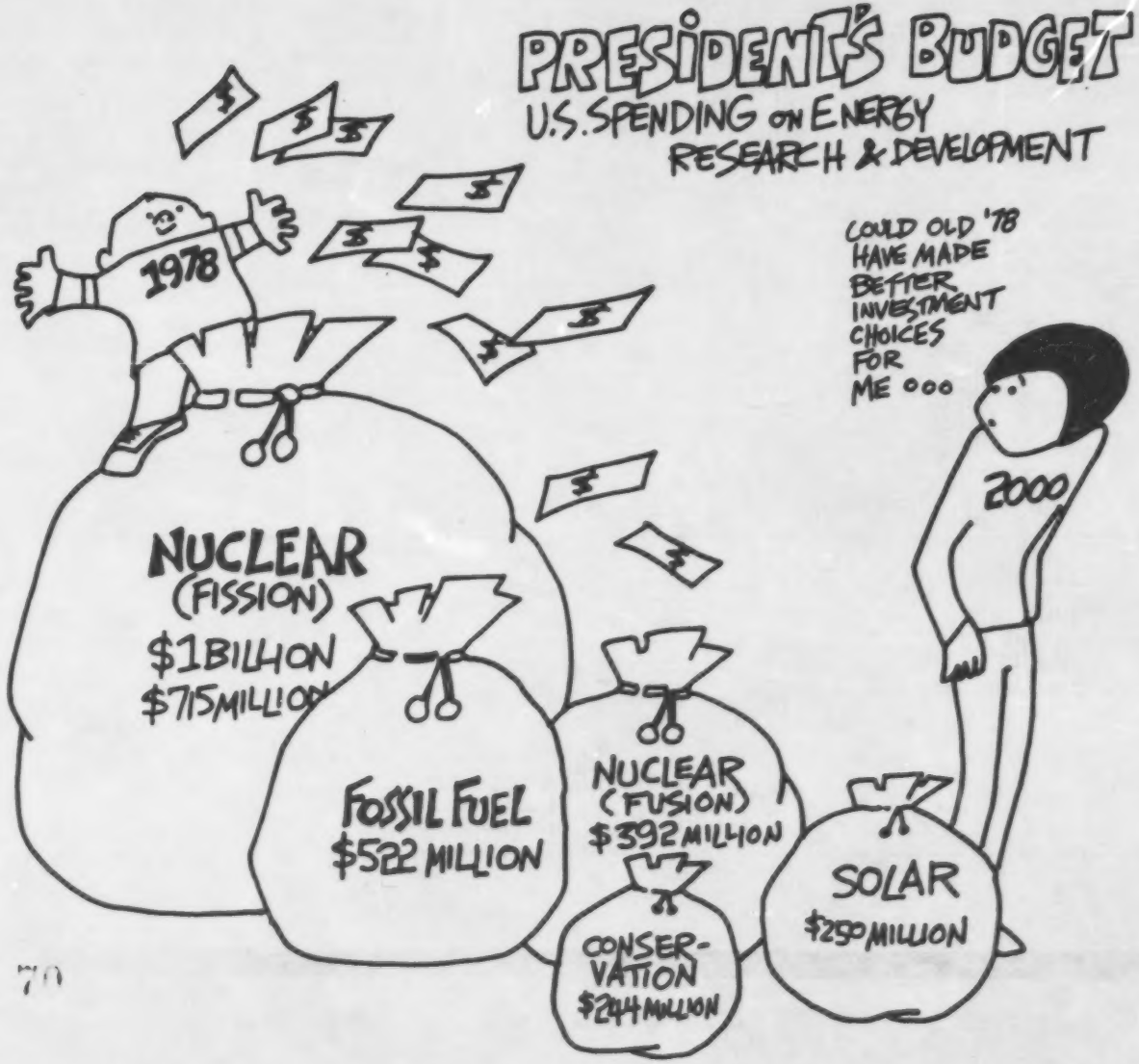
Name two other investments that must be made now so that savings can be made in the future.

NEW SOURCES OF ENERGY FOR ELECTRICITY



S8

S9



1. Define Research and Development.

2. On what type of energy research and development does the President want to spend the most money?

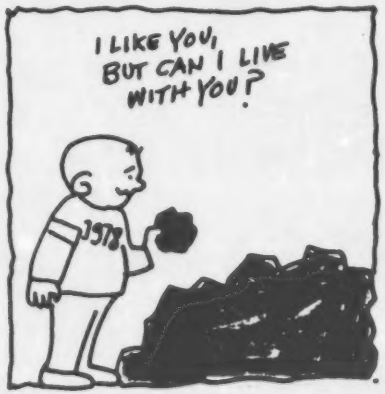
3. How do decisions of 1978 influence 2000?

Top Ten Owners of Coal Reserves in U.S. (1975)

1. Continental Oil
2. Burlington Northern
3. Union Pacific
4. Peabody Coal
5. Exxon (Carter Oil)
6. AMAX (20.6% Standard Oil of California)
7. North American Coal
8. Occidental Petroleum
9. U.S. Steel
10. Kerr McGee

The U.S. has over 390 billion tons of coal recoverable at today's prices. This coal may contain more than 5 times the energy in Middle Eastern Oil Reserves.

Developing coal takes both time and money. Opening a surface mine takes 3 to 5 years. Underground mines may take 5-7 years to develop. It costs 20-30 million dollars to open a new surface mine; 40-60 million dollars for a new deep mine.



Top Ten Coal Companies in U.S. (1974)
1. Peabody Coal Co.
2. Consolidated Coal Co.
3. Island Creek Coal Co.
4. Amax Coal Co.
5. The Pittston Co.
6. The U.S. Steel Corp.
7. Arch Mineral Corp.
8. Bethlehem Mines Corp.
9. N. American Coal Corp.
10. Peter Kewit Sons Mining Division

Miners make between $14,000 and $20,000 a year.

Number of Mine Workers in the United States (1976)	
Underground Miners	123,000
Strip Miners	44,000
Related jobs in the mines	17,000
TOTAL	184,000

The following products come from coal:

steel	*nylon*	*plastic*
perfume	*aluminum*	*paint*
dye	*aspirin*	*detergent*
insecticide		*motor fuel*
drugs	*rubber*	*food preservatives*

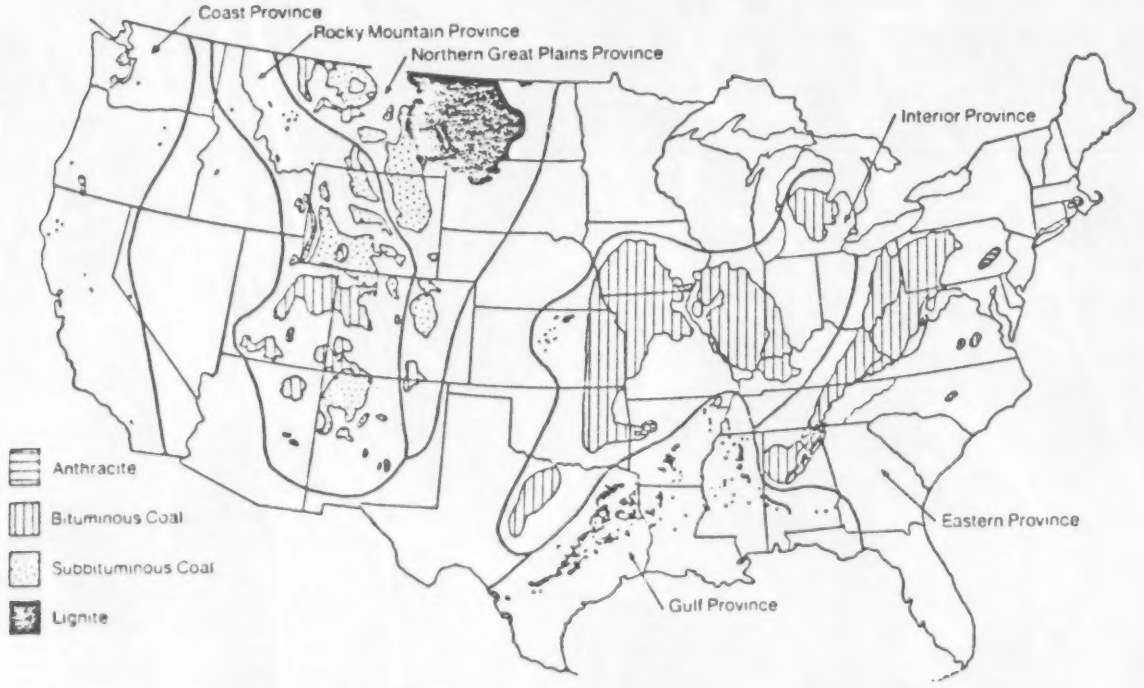
Jobs Needed to Produce Coal

miners
drill operators
cutting machine operators
locomotive operators
loading machine operators
electricians
lubricating specialists
masons
pipefitters
repairmen
power shovel operators
roof bolter operators
tipple machinery operators
carpenters
construction workers
explosives handlers
machine-tool operators
mechanics
plumbers
truck & tractor mechanics

Heat and pressure applied in the right way can convert a 4 pound piece of coal into about 1 quart of synthetic crude oil or about 32 cubic feet of synthetic gas. These are very expensive products.

47% of the electricity used in the U.S. comes from coal.

Distribution of United States Coal Resources



Source: Bureau of Land Management, Draft Environmental Impact Statement: Proposed Federal Coal Leasing Program 1974

The burning of coal can produce sulfur and nitrogen oxides, soot, and ash. Depending on the type of coal that is burned, these pollutants can produce mild or severe damage to the environment and to people.

Surface Mining can hurt the natural environment. As the coal is stripped away, so is much of the topsoil. Laws requiring reclamation of land do help. This is not always possible. Large amounts of water are needed and water is often in short supply. Reclamation adds to the cost of coal production.

Underground mining is a dirty and sometimes dangerous job. There are more job related accidents in coal mining than any other industry in the U.S.

The use of strip mining as a means of getting at coal is increasing. In 1960, 25% of the coal was strip mined. By 1970, about half of the coal was strip mined.

COAL: THE COSTS AND BENEFITS

The United States must make some major decisions about energy for the near future. Many experts point out that the demand for energy is growing faster than the supply of energy. This scarcity of energy will create serious problems.

Assume that you are an advisor to the President. The President wants to know if the nation should increase its production of coal.

To make a good decision, the President must know what are some of the benefits and some of the costs of increased coal production.

Examine the data on the Coal Facts sheet.

List five costs and five benefits of coal production. Remember that costs and benefits include not only money but also changes in the number of jobs, foreign relations, working and living conditions.

Benefits of increased coal production	Costs of increased coal production
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

Look back at the costs and benfits that you have listed.

Put a star before the most serious cost and the most important benefit.

On what basis did you make that decision?

THE PRESIDENT'S CABINET

The President has called a Cabinet Meeting. Each person at the Cabinet meeting must give advice for or against increasing coal production. At the end of the meeting, the President must decide what to say to Congress and the nation.

Some of the Cabinet Members are listed below. Choose one of the roles.

The President	The President conducts the meeting, asks questions, and finally, decides what to do.
Secretary of State	The Secretary of State is interested in foreign affairs. How will increased coal production change relations of the U.S. with the rest of the world? Will this generally be good or bad?
Secretary of Transportation	The Secretary of Transportation is interested in seeing that people and materials are able to move around the country. Will increased coal production help the nation's transportation problems?
Secretary of the Interior	The Secretary of the Interior is interested in the land. Will increased coal production seriously harm the land? Will there be enough water for all purposes?
Secretary of the Treasury	The Secretary of the Treasury must help the government pay its bills. Will the increased production of coal add to taxes or add to the government's expenses?
Secretary of Labor	The Secretary of Labor is interested in seeing that people have good jobs. Will the development of coal help create these jobs?
Secretary of Health, Education and Welfare	The Secretary of HEW is interested in the health and well being of the people. How will the increased production of coal influence the health and safety of the people?

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NUCLEAR FISSION: COSTS AND BENEFITS

Few suggestions for dealing with the scarcity of energy are as controversial as the use of nuclear power. At present about 8 percent of the energy used in this country comes from nuclear fission. Some people predict that this will increase to 20 percent by 1985. If the United States were to invest large sums of money into nuclear power plants, this percentage could be even higher by the year 2000.

Read the following brief selection. You will have to decide if the costs of producing more energy from nuclear power are greater or less than the benefits that could be gained.

******* ******* ******* ******* ******* *******

Environment

Nuclear power plants do not cause the same type of air pollution as coal power plants. Also, since the energy potential of uranium is great, only small amounts of uranium ore must be mined. This reduces the problems of strip mining.

Nuclear fission does produce radioactive material. This material is very dangerous and must be kept out of contact with food, water, or any part of the living biosystem. Since it remains dangerous for hundreds of years it must be stored very carefully. So far the storage problem has not been solved.

Safety

There are very strict safety guidelines for nuclear power plants. There are no radioactive emissions that are dangerous to people living near the plant. Some people are worried about the reactor blowing up. While they can't explode like a "nuclear bomb," it is possible that, for instance, the cooling systems might fail and the nuclear material get so hot it would melt. This could cause a small explosion (because of steam pressure) which would spread radioactive materials over the neighborhood. If

an accident did occur, it would be disastrous. However, chances of this seem to be extremely small.

There is also a danger that hi-jackers could steal nuclear material and make a bomb. With present day reactors this is not a threat but if we use breeder reactors or begin to reprocess used reactor fuel, it could become a danger.

Independence

The increased use of nuclear power could replace some oil and help the United States to be less dependent on foreign nations for energy. Uranium is the primary ore used in nuclear plants. Estimates on the amount of economically recoverable uranium in the United States vary. There probably is enough to fuel all of the reactors now operating or being built for their 30-40 year lifetime.

Economics

Nuclear power plants are fairly economical to operate since the fuel costs are low (much lower than coal, for instance). They are, however, very expensive to build, more expensive than coal-fired plants. If the United States builds a large number of nuclear reactors less money will be available to invest in other energy sources or in other parts of the economy.

Politics

Nuclear power plants are large. They often provide energy for many states. Although many areas need the energy, very few people are willing to allow the plants to be built in their community. There could be conflict between the states and the Federal government over where to build new plants. There are also many people and many organized groups who strongly oppose nuclear power for the reasons mentioned above and they are fighting against its further development.

BEDTIME STORY

"When I was little, Mommy and Daddy used to drive us around in cars just for fun."

redrawn from Charles Saxon cartoon THINK Oct/Nov 1976

Is this cartoon set in the past, present or future?

How do you know?

For what purposes does this family use a car?

How do you know?

Does this family use a car more or less than your family?

Why do you think so?

POSSIBLE FUTURE ENERGY SITUATIONS

1. No decisions were made to increase the supply of energy.

2. In 1980 the United States decided to invest all its energy money in developing solar power.

3. In 1980 the United States decided to invest all its energy money in developing nuclear fusion.

4. In 1980 the United States decided to invest all its energy money in increasing coal production.

5. Major conservation efforts were successful.

Type	Process Description	Assets	Problems	Estimated Availability
Solar Cell	The particles making up a beam of light (called photons) knock electrons loose from atoms in a device called a solar cell. These electrons can be collected to produce electric power	1. Little maintenance required. 2. Long lasting. 3. Sunshine is free and renewable.	1. Extremely expensive. 2. Requires a large amount of land. 3. Sunlight is variable and some storage or back-up will be needed.	Some by 1985; Commercially competitive by 2000, may be sooner.
Thermal	Collect sunlight and heat a liquid to create steam. This steam spins a turbine which rotates generator coils and produces electricity.	1. No pollution or other environmental hazards. 2. Sunshine is free and renewable.	1. Relatively expensive. 2. Requires a large amount of land. 3. No feasible way as yet to store heat at night or when the sun isn't shining.	Some by 1985; Commercial availability by approximately 1995.
Sea Power	The warm surface water of the ocean can be used to heat a fluid such as ammonia causing it to change into a vapor. This vapor, which will be at a relatively high pressure, can then be used to turn a turbine and power an electric generator. The vapor is then cooled back to a liquid by the cooler water deep in the ocean.	1. Sunshine is free and renewable. 2. The ocean is a large solar collector.	1. Much to be learned about operation of complex equipment in an ocean environment. 2. Little is known about the effects of storms on the large floating structures which are envisioned. 3. Transmission of power from ocean sites is difficult and expensive.	Very questionable. Some small scale testing by 1985.

ELECTRICITY FROM CONTROLLED NUCLEAR FUSION

Process Description

Nuclei of 2 atoms join together ("fused"), releasing energy. Nuclei normally repel each other and therefore, force must be used to bring them close together and cause them to react. In order to do this, heavy hydrogen (D) must be heated to about 100 million degrees C so that the nuclei will be moving very fast and collide. The heated nuclei (called "plasma") are confined by a magnetic field while they are heated.

Assets

1. "D" is cheap and plentiful.
2. Little, if any, air pollution.
3. No threat of nuclear explosion and only small amount of radioactivity.

Problems

1. Some doubt that a working plant can be built because of many technical problems. Experts are not sure if this process can be controlled.
2. Plants may be so expensive that the electric power will not be economical.

Estimated Availability

The scientific problems may be solved by 1985. Some power by year 2000. Unlikely for commercial availability until many years later.

WRITE A LETTER

Write a letter to the President or to your Congressman. In the first paragraph state the type of long range energy options you would like to see developed. In the second paragraph explain why you support this option. In the third paragraph identify some of the problems with your options. State why you think these are less important than the positive parts of the option.

*U.S. GOVERNMENT PRINTING OFFICE : 1980 O-311-122/13